

# **Plywood Manufacture**

Plywood is an assembly of layers of wood (veneer) joined together by means of an adhesive (glue). It is a multi-use material characterized by its ability to be designed and engineered for construction and decorative purposes, flat shapes, curves, and bent shapes. There are two types of plywood: hardwood and softwood. Hardwood plywood is generally used for decorative purposes and has a face ply of wood from broad leaf trees. Softwood plywood is generally used for construction and structural purposes, and the veneers are of wood from needle bearing trees. Most plywood plants make their own veneers at plant sites.

There are approximately 42 facilities that produce plywood in Washington: 30 Softwood Veneer and Plywood (SIC 2436) and 12 Hardwood Veneer and Plywood (SIC 2435) (some of these facilities may produce both and are listed twice) (Ecology, 1/20/98).

## **Description of Process**

A great assortment of woods are utilized in the manufacture of veneers. A high percentage of veneer produced in the northwest is manufactured from Douglas fir, with lesser quantities of veneer made from ponderosa pine and hemlock.

The various operations for converting roundwood into veneer and finally into plywood are relatively simple and chiefly mechanical.

Veneers are cut to thicknesses ranging from 1/40 to 3/8 inch. After veneers are cut, they may go directly to a clipper or they may be stored temporarily on horizontal storage decks or on reels. From there the veneers are conveyed to the dryers.

Freshly cut veneers are ordinarily unsuited for gluing because of their wetness. It is therefore necessary to remove the excess moisture rapidly, and veneers are usually dried to a moisture content of less than 10 percent. This is a level compatible with gluing, and consistent with the moisture content to which plywood products will be exposed during construction.

Several methods for drying veneers are in use. The most common type of dryer is a long chamber equipped with rollers on belts which advance the veneer longitudinally through the chamber. Fans and heating coils are located on the sides of the chamber to control temperature and humidity.

The majority of high temperature (above 100°C or 212°F) veneer dryers depend upon steam as a heat source. The heat is transferred to the air by heat exchangers. However, direct-fired oil and gas dryers are becoming increasingly common in the industry.

A number of adhesives can be used in the manufacture of plywood. For the purpose of this discussion, distinction is made between (1) protein and (2) phenol-formaldehyde and urea-formaldehyde glues, since these are the classes of glue most often used in the industry. Protein glue is extracted from plants and animals, and typical ingredients are water, dried blood, soya flour, lime, sodium silicate, caustic soda and a formaldehyde donor for thickening while the other

two are synthetic, thermosetting glues. Urea-formaldehyde glues are synthetic thermosetting glues and typical ingredients are water, defoamers, extenders (wheat flour) and urea-formaldehyde resin. Phenol-formaldehyde resin are also synthetic thermosetting glues and typical ingredients include additives of caustic soda and soda ash.

Both protein and urea-formaldehyde are chiefly interior glues (less water resistance), while phenol-formaldehyde is an exterior glue (good water resistance). Urea-formaldehyde is used almost exclusively in the hard plywood industry where panels are used for furniture and indoor panelling.

Most plywood manufacturers mix their own glue in large dough-type mixers. The glue is then applied to the veneer by means of a spreader, the most common of which consists of two power driven rollers supplied with the glue. More recently the practice of applying glue by means of sprays and curtain coaters has become common.

After gluing, the layers of veneer are subject to pressure to insure proper alignment and an intimate contact between the wood layers (veneers) and the glue. The glue is allowed to partially cure under pressure. Pressing may be accomplished at room temperature (cold pressing), or at high temperature (hot pressing). Hot pressing equipment is used to cure some protein, some urea-formaldehyde, and all of the phenol-formaldehyde glues.

Most pressers are hydraulic and apply pressure from 75 to 250 psi. Cold pressers are operated at room temperatures, while hot pressers are operated at temperature up to 350°F with heat being transferred by means of steam, hot water or hot oil. Plywood pressing time ranges from two minutes to many hours depending upon the temperature of the press, size of plywood and type of glue used. Usually, the hotter the press, the shorter the pressing time.

After the pressing operation, any number of a series of finishing steps, depending upon the operation and the product desired, may be taken.

## **Method of Determining Emissions**

A considerable amount of time was spent to locate air quality data, specifically air toxics emissions data, from plywood/veneer manufacturing. Several EPA and industry studies involving source testing were found. Most of these studies involved particleboard and waferboard plants. One study addressed a plywood plant. These studies have basically concentrated only on formaldehyde and phenol. These studies also addressed the chemical and physical nature of the emissions from the veneer dryers used in the plywood industry.

According to a Washington State University (WSU) study, the emissions from plywood veneer dryers are relatively small and almost totally hydrocarbon (mostly terpenes).

WSU estimated that a typical veneer dryer emits material (hydrocarbon) equivalent to 74 acres of a mid-latitude coniferous forested area. (WSU, 1982)

Veneer dryer emissions characteristically have a blue haze. This blue haze is due to hydrocarbon condensation after leaving the dryer stack. The particulate matter formed has a diameter in the range of tenths of microns. WSU has studied the composite of this haze in detail (WSU, 1982).

Emissions of formaldehyde and phenol from the existing plywood/veneer plants are affected by the percent free formaldehyde and phenol in the glue (resin) composition, not by how many plywood panels are being made by the plywood plants. Some major factors in determining emission rates are: 1) Age of the industry and equipment, and 2) Type of plywood being made.

If they are making high density overlays which use glues with a high percentage of free formaldehyde, the emission rate may be as high as 1.0 lbs/103 sq.ft. board. At the same time, when the industry is making low density overlays, toxics emissions could be as low as 0.025 lbs/103 sq.ft. Therefore, the recommendation to permit writers is to develop a specific emissions rate for each plywood plant, using the industry's annual glue use and glue composition. This information is provided in the material safety data sheets that the glue companies provide to the plywood industries.

## References

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